Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with 'A+' Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore - 641 043, Tamil Nadu, India

Bachelor's Degree Examination – June 2021
VI Semester

Class : III UG **Time : 3 hours**
Major : Physics **Max. Marks: 100**

18BPHC23 Quantum Mechanics and Relativity

Part A **10 x 1 = 10**
Choose the Correct Answer

1. If the positional inaccuracy of a particle is of the order of 10^{-8} m, then the uncertainty in its momentum is _____ CO1 K 3
   a. 10^{-26}m b. 10^{-16}m c. 10^{-6}m d. 10^{36}m

2. The deBroglie wavelength of an electron whose speed is 10^{8} m/s is CO1 K 3
   a. 7.28×10^{-12}m b. 6.28×10^{-12}m c. 7.28×10^{-11}m d. 7.28×10^{-10}m

3. The quantum mechanical operator for energy is CO2 K1
   a. $-i\hbar\frac{\partial}{\partial t}$ b. $-i\hbar\nabla$ c. $i\hbar\nabla$ d. $i\hbar\frac{\partial}{\partial t}$

4. Different wave function with different quantum numbers may have the same energy value. Such a condition is called as CO2 K1
   a. Non-degeneracy states b. Degeneracy state c. Dependent states d. none

5. The normalized wave function of the particle in a box of width L is CO3 K1
   a. $\psi_n = \sqrt{\frac{3}{L}}\sin\frac{n\pi x}{L}$ b. $\psi_n = \sqrt{\frac{2}{L}}\sin\frac{n\pi x}{L}$
   c. $\psi_n = \sqrt{\frac{L}{3}}\sin\frac{n\pi x}{L}$ d. $\psi_n = \sqrt{\frac{L}{2}}\sin\frac{n\pi x}{L}$

6. Potential well of a linear harmonic oscillator is CO3 K1
   a. ellipse b. circle c. parabola d. triangle

7. Galilean transformation shows that CO4 K2
   a. mass is invariant b. acceleration is invariant
   c. time is invariant d. all the above

8. The clock in a moving frame of reference will appear to go_____than the clocks in the stationary frame of reference. CO4 K2
   a. Slower b. faster c. almost equal d.none of the above

9. If the mass of the moving particle is tripled its rest mass, then its speed is ____ CO5, K3
   a. 0.9c b. 0.94c c. c d. 0.1c

10. 1Å= _____ CO5, K1
    a. 10^{-9}m b. 10^{-10}m c. 10^{-11}m d. 10^{-12}

Part B 5 x 6 = 30

Answer ALL questions

Each answer should not exceed 400 words or two pages

11.a. State Heisenberg uncertainty Principle and explain with any one illustration.	CO1 K4
(or)	
11.b. Describe G.P Thomson's Experiment.	CO1 K2
12.a. Explain the Physical significance of the wave function.	CO2 K2
(or)	
12.b. Explain the postulates of Quantum Mechanics.	CO2 K2
13.a. Derive Schrodinger wave equation for the Hydrogen atom .	CO3 K3
(or)	
13.b. Find the probability that a particle trapped in a box L wide can be found between 0.45L and 0.55L for the ground and the first excited states.	CO3 K3
14.a. State and deduce the mathematical expression for the law of addition of relative velocities.	CO4 K4
(or)	
14.b. Describe the Lorentz – Fitzgerald length contraction.	CO4K2
15.a. Explain minikowski's four dimensional space-time continuum.	CO5 K2
(or)	
15.b. Explain the following terms, a. Gravitational red shift b. Black hole	CO5 K2

Part C 5 x 12 = 60

Answer ALL questions

Each answer should not exceed 800 words or four pages

16.a. Describe Davisson and Germer experiment to confirm the existence of De Broglie waves.	CO1 K2
(or)	
16.b. Define group velocity. Obtain an expression for phase and group velocities of de Broglie waves.	CO1 K3
17.a. Derive time dependent Schrödinger's equation. What is the meaning of wave function?	CO2 K4
(or)	
17.b. Derive time independent Schrödinger's equation.	CO2 K4
18.a. A particle is bound in one dimensional infinite potential well. Determine the energy eigen values and energy eigen functions. Sketch the form of the wave function for n = 1, 2, 3.	CO3 K4
(or)	
18.b. Explain the application of Schrodinger wave equation in linear harmonic oscillator.	CO3 K4
19.a. Describe the Michelson-Morley experiment and explain the physical significance of negative results.	CO4 K4
(or)	
19.b. State the postulates of special theory of relativity and Derive Lorentz transformation equations.	CO4 K4
20.a. Derive Einstein's mass energy relation.	CO5 K3
(or)	
20.b. Elaborate the general theory of relativity.	CO5 K3

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